

Amendments to the Specification

Please replace the title as follows:

~~FERROELECTRIC FILM, FERROELECTRIC CAPACITOR AND METHOD OF
FABRICATING THE SAME, FERROELECTRIC MEMORY, PIEZOELECTRIC
ELEMENT AND SEMICONDUCTOR ELEMENT~~
FERROELECTRIC FILM, FERROELECTRIC CAPACITOR, FERROELECTRIC
MEMORY, PIEZOELECTRIC ELEMENT, SEMICONDUCTOR ELEMENT, METHOD
OF MANUFACTURING FERROELECTRIC FILM, AND METHOD OF
MANUFACTURING FERROELECTRIC CAPACITOR

Please replace the paragraph beginning on page 10, line 4, to line 12 with the following rewritten paragraph:

A PZT-family ferroelectric according to an embodiment of the present invention is described by a general formula ABO_3 , Pb is included as a constituent element in an A site and at least Zr and Ti are included as constituent elements in a B site. Amount of Pb vacancy in the A site is equal to or less than 20 mol% of the stoichiometric composition of the ABO_3 . This PZT-family ferroelectric film may include Nb in the B site with a compositional ratio equivalent to ~~half~~ twice the Pb vacancy in the A site. With this PZT-family ferroelectric film, a Ti composition may be higher than a Zr composition in the B site, and also the ferroelectric may have a crystal structure of rhombohedral system. This PZT-family ferroelectric film may be formed by using a sol-gel solution.

Please replace the paragraph beginning on page 18, line 15, to line 25 with the following rewritten paragraph:

The ferroelectric capacitor 100 also has the features described below, with respect to the hysteresis characteristic. If a voltage V_s is applied and the polarization magnitude has gone to $P(+V_s)$ then the applied voltage goes to 0, the hysteresis loop follows the path indicated by the arrow A in Fig. 3 and the polarization magnitude holds the stable value $PO(0)$. If a voltage $-V_s$ is applied and the polarization magnitude has gone to $P(-V_s)$ then the applied voltage goes to 0, the hysteresis loop follows the path indicated by the arrow B in Fig. 2-3 and the polarization magnitude holds the stable value $PO(1)$. Thorough utilization of this difference between the polarization magnitude $PO(0)$ and the polarization magnitude $PO(1)$ makes it possible to operate a simple matrix type of ferroelectric memory device by the drive method disclosed in Japanese Patent Laid-Open No. 9-116107.

Please replace the paragraph beginning on page 20, line 22, to line 27 with the following rewritten paragraph:

Tests were also performed on an SiO_2 film-~~604~~ 605 formed by ozone TEOS on a ferroelectric capacitor 600 in which a lower electrode-~~601~~ 602, a PZTN ferroelectric film 603 of this embodiment, and an upper electrode-~~603~~ 604 are formed on a substrate 601, as shown in Fig. 12. It is known in the art that, if an SiO_2 film is formed by ozone TEOS on PZT, the hydrogen emitted by the TEOS passes through the upper Pt and reduces, and the PZT crystal is so destroyed that the hysteresis phenomenon does not occur.

Please replace the paragraph beginning on page 24, line 18, to line 20 with the following rewritten paragraph:

First of all, a given substrate-~~10~~11 was prepared, as shown in Fig. 23A. A TiOx layer formed on an SOI substrate was used as the substrate-~~10~~11. Note that a preferred material could be selected from known materials as this substrate-~~10~~11.

Please replace the paragraph beginning on page 31, line 10, to page 32, line 5 with the following rewritten paragraph:

Figs. 33A and 33B show results obtained by measuring the hysteresis characteristics of capacitors in which the manufacture method of this embodiment was employed to form a SiO₂ protective film by using TMS over a ferroelectric capacitor formed of a Pt lower electrode, a PZTN ferroelectric film, and a Pt upper electrode, when the PZTN ferroelectric film was subjected to thermal processing in an oxygen atmosphere or air after this SiO₂ protective film was formed. Fig. 33A shows the results of thermal processing in an oxygen atmosphere and Fig. 33B shows the results of thermal processing in air. Figs. 33A and 33B show that hysteresis characteristics with good squareness were obtained, regardless of whether the thermal processing was done in an oxygen atmosphere or air, even though a hydrogen-resisting barrier film was not formed. This is because preliminary thermal processing was performed in an oxidizing atmosphere during the formation of the ferroelectric film-~~30~~101 so that the oxygen necessary for the crystallization had previously entered the film. In other words, the manufacture method of this embodiment makes it possible to crystallize the ferroelectric film without being dependent on the atmosphere for thermal processing. In addition, when the thermal processing for crystallization is performed in a non-oxidizing gas atmosphere, it is possible to prevent oxidation damage due to high-temperature thermal processing on peripheral components (for example, metal wiring) other than the capacitor, when applied to a method of manufacturing a ferroelectric memory that will be described later. Note that since the thermal processing for crystallizing the PZTN complex oxide in this process is not very dependent on the type of gas in the atmosphere,

contact holes for forming metal wiring for connecting the upper electrode 103 to the exterior can be formed after the protective film 104 is formed.

Please replace the paragraph beginning on page 37, line 23, to line 38, line 13 with the following rewritten paragraph:

A partial perspective view of parts of an inkjet-type recording head in accordance with an embodiment of the present invention is shown in Fig. 39, a plan view and a section taken along the line A-A' of Fig. 39 are shown in Fig. 40A and Fig. 40B, and a schematic view of the layer structure of a piezoelectric element 700 is shown in Fig. 41. As shown in these figures, a flow path shaping substrate 10 is formed of a (110)-orientation silicon monocrystalline substrate in accordance with this embodiment, and an elastic film 50 of thickness 1 to 2 μm is formed of silicon dioxide by previous thermal oxidation on one surface thereof. A plurality of stress generating chambers 12 are arrayed in the widthwise direction of the flow path shaping substrate 10. A connective portion 13 is formed in the longitudinal direction of a region on the outer side of the stress generating chambers 12 of the flow path shaping substrate 10 and the connective portion 13 and the stress generating chambers 12 communicate through an ink supply path 14 provided for each stress generating chamber 12. Note that the connective portion 13 forms part of a reservoir 800 that forms a common ink chamber for the stress generating chambers 12 communicating with a reservoir portion of a sealing substrate 30 that will be described later. Each ink supply path 14 is formed to width that is narrower than the stress generating chamber 12, to keep the resistance of ink flowing into the stress generating chamber 12 from the ink supply path 14 constant.

Please replace the paragraph beginning on page 38, line 18, to page 39, line 14 with the following rewritten paragraph:

On the opposite side from the aperture surface of the flow path shaping substrate 10, the elastic film 50 of a thickness of approximately 1.0 μm , by way of example, is formed as

mentioned previously, and a dielectric film 55 of a thickness of approximately 0.4 μm , by way of example, is formed on that elastic film 50. In addition, a lower electrode film 60 of a thickness such as approximately 0.2 μm , a piezoelectric layer 70 of a thickness such as approximately 1.0 μm , and an upper electrode film 80 of a thickness such as approximately 0.05 μm are formed in a stack on the dielectric film 55 by processing that will be described later, to form the piezoelectric element 700. In this case, the piezoelectric element 700 is the portion including the lower electrode film 60, the piezoelectric layer 70, and the upper electrode film 80. In general, one electrode of the piezoelectric element ~~300~~ 700 is a common electrode and the other electrode and the piezoelectric layer 70 are patterned to form each stress generating chamber 12. A portion formed of the thus-patterned electrode and the piezoelectric layer 70 that generates piezoelectric strain by the application of a voltage to the two electrodes is called an active piezoelectric portion. With this embodiment, the lower electrode film 60 is the common electrode of the piezoelectric element 700 and the upper electrode film 80 is the other electrode of the piezoelectric element 700, but there is no obstacle to reversing these roles to suit the circumstances of the drive circuit or wiring. In either case, an active piezoelectric portion is formed for each stress generating chamber. In this case, the combination of the piezoelectric element 700 and the vibrating plate in which displacements are generated by the driving of that piezoelectric element 700 is called a piezoelectric actuator. Note that the piezoelectric layer 70 is provided independently for each stress generating chamber 12 and is configured of a plurality of layers of ferroelectric film 71 (71a to 71f).